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ISSUE No. T.273.

The Claudel-Hobson Carburettor

MODELS R.A.F., Z. & H.C.7.,

for

Aero Engines.

INSTRUCTION MANUAL.

FEBRUARY, 1918.

Issued by
TECHNICAL INFORMATION SECTION,
T.3.F.,
AIR BOARD.

MODIFICATIONS, July 1918.

Since this instruction book was printed, various modifications have been made in the H.C.7 and H.C.8 carburetters. Particulars are given in the subjoined drawings and letterpress.

1. Fixing of the Diffuser Tubes.

The inner diffuser tubes of the earlier carburetters occasionally worked loose. As the consequences of this are obviously serious, no diffusers may now be used unless the tube is expanded into the base. Early issues may be corrected by means of the special drift shown in Fig. 1. The diffuser is placed in a holder, and held in a vice. The drift is inserted in the depression tube, and expanded by a few sharp blows with a hammer. The depth to which the drift is required to be driven should be tested until a point is reached when there is sufficient lock: this should be obtained by four or five sharp blows.

2. Removal of the Adjustable Cones.

These cones tend to damage the diffusers by vibration, and a small increase of power is obtained by deleting them. The cones and operating mechanism are removed, and the spindle bearing holes are plugged. All sharp edges left in the air intake after removing the cones must be rounded off and streamlined as far as possible; this especially applies to the diffuser brackets. This modification is retrospective. The decrease in resistance necessitates the use of larger jets than were employed with the cones in use. The new jet sizes are specified in A.I.D. instructions for each type of engine concerned.

3. Jets to be Mounted in Series.

With the jets in parallel, the pilot jet draws petrol through the slow-running tube and also direct from the main supply; thus it continues to deliver petrol at all throttle positions. With the jets in series, all petrol passes through the main jet, and a supply enters the slow-running tube through the holes situated 90 mm. from the top of the tube. As the reserve of petrol in the diffuser sinks below these holes, the slow-running jet ceases to deliver, and perceptible fuel economy results at cruising speeds. Fig. II. shows the standard series arrangement of the jets. Any carburetters with jets in parallel are to be altered immediately. No variation of the series arrangement or of the dimensions or positions of the holes is permissible.

4. Countersunk Main Jet Holes.

In the removal of main jets for cleaning purposes the spanner often burrs the edges of the jet orifice. These holes will in future be countersunk. Existing jets will need re-calibration after being countersunk.

5. Vacuum Control Bush and Plug.

In the earlier issues of this carburetter the altitude control had too great a range, and the action was too sudden over the latter part of the range. In order to reduce the range and smooth the action of the control, the holes in the control bush have been altered to 2 mm. slots, which are gradually uncovered by the slots in the control plug working inside the bush. Cocks of the old pattern must be exchanged for modified cocks without delay. The air leak hole of the pressure balance system is always in operation with the modified cock.

6. Integral Choke Tubes.

To lessen manufacturing cost and increase volumetric efficiency, the old type of separate choke tube is now superseded by a choke tube made integral with the carburetter body.

7. Alterations to Throttle.

The direction of the opening of the throttle barrel is now reversed, so that the choke tube end of the suction duct is not shielded in partially closed throttle positions. The action of the control must be reversed to suit—*i.e.*, the operating rod must pull, instead of pushing, to open the throttle as formerly. Installation drawings must be amended to suit this change.

The strangler slot in the barrel is to be increased in width from 4 mm. to 5 mm. to provide a larger clearance, in the event of uneven washers throwing the diffuser tube slightly out of line.

8. Manufacture of Pilot Jets.

In the past separate pilot jets have been soldered into the slow-running tubes. Manufacturers are now permitted to mount the tube on a mandril of the exact diameter specified for the bore of the pilot jet. The slow-running tube is then swaged down on to the mandril at the point where the pilot jet restriction is to be located.

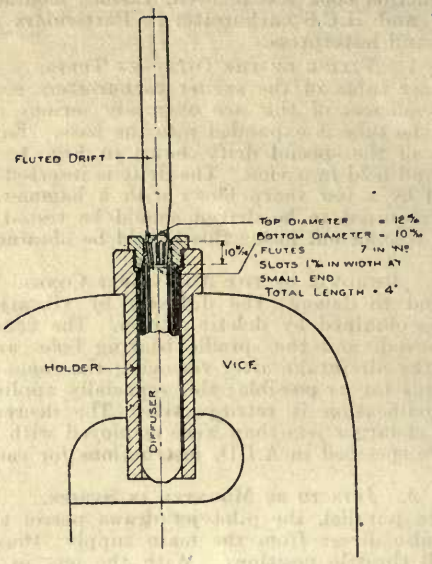
FLUTED DRIFT
TOP DIAMETER = 12%
BOTTOM DIAMETER = 10%
FLUTES 7 IN No
SLOTS 1% IN WIDTH AT SMALL END
TOTAL LENGTH = 4"
10%
HOLDER
VICE
DIFFUSER

FIG. 1.

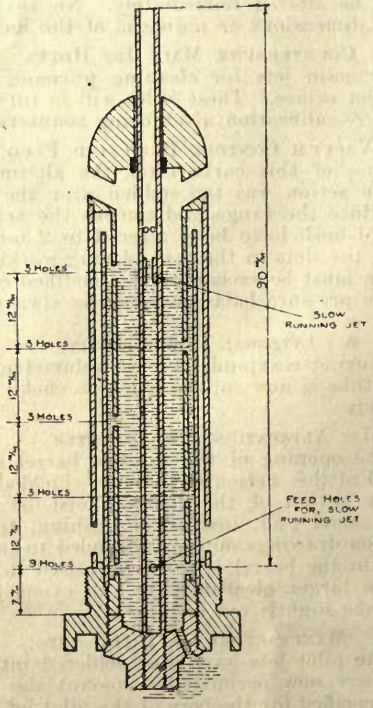
3 HOLES
12%
3 HOLES
12%
3 HOLES
12%
3 HOLES
12%
9 HOLES
2%
30%
SLOW RUNNING JET
FEED HOLES FOR SLOW RUNNING JET

FIG. 2.

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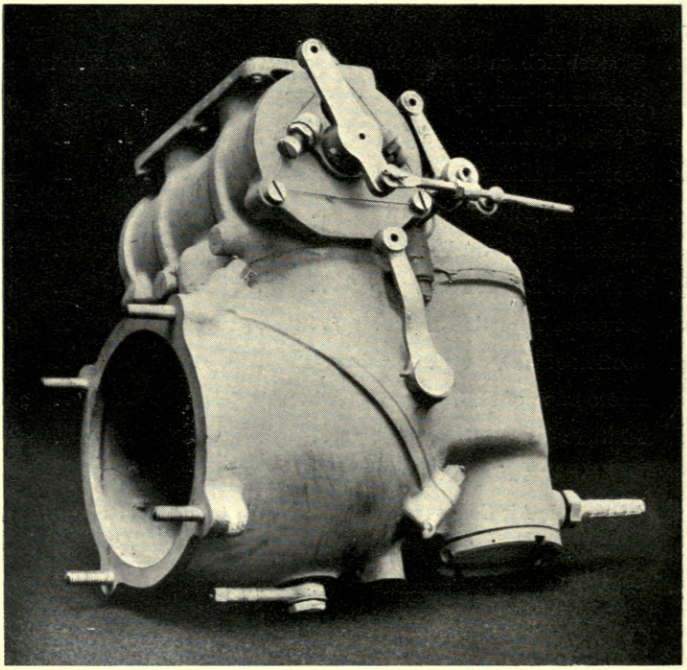
FIG. 1.



Claudel-Hobson Carburettor, Type HC7.

GENERAL DESCRIPTION OF THE CARBURETTOR.

The two outstanding features of the Claudel-Hobson carburettor are the peculiar construction of the jet and of the throttle.

The Principle of the Jet.

In most types of carburettor pure petrol is drawn from the spraying jet or nozzle, and the petrol is neither atomised nor mixed with air until after it quits the jet. The Claudel carburettors are fitted with two distinct patterns of spraying nozzle, described below. The earlier carburettors, known as the R.A.F. models, possess what is known as an " air injector " type of jet, and the later models, known as the " Z " and " HC " types, are equipped with a " diffuser," mounted above a jet placed towards the foot of the spraying chamber. Both the air injector and the diffuser types commence to atomise the petrol and to mix it with air before it emerges into the main stream of air drawn up from the principal air intake. Thus, when the main stream of air reaches the delivery nozzle in the spraying chamber, instead of receiving a coarse spray of semi-liquid petrol, it is met by a fine, mistlike vapour consisting of richly carburetted air. The petrol is already broken up, and as the jets of vapour impinge across the main air column at an angle from a ring of emulsion holes drilled round the sides of the delivery nozzle, the process of atomising the petrol and carburetting the air is carried out with peculiar completeness and efficiency. In conjunction with the special type of throttle employed, both patterns of jet automatically adjust the proportions of air and petrol in the mixture to suit the varying needs of the engine.

The Principle of the Throttle.

The throttle is of the revolving barrel type, which combines a delicately graduated control of the gas supply with a frictionless path for the gases at full throttle openings. For such engines as require a fine slow-running adjustment, the special feature of the Claudel-Hobson motorcar type

of throttle is retained, though sometimes in a modified form. This takes the form of a curiously shaped slot, roughly resembling a cloverleaf, cut in the lower half of the throttle barrel or drum. In such air injector models as possess this slot, its outline closely resembles that of a cloverleaf; but the slot has narrower and longer slots in the diffuser models, for reasons which are explained below. When the throttle is closed, the delivery nozzle protrudes through the cloverleaf slot into the interior of the throttle barrel. The slot then acts as an air regulator or strangler, and concentrates the reduced suction of the engine around the head of the delivery nozzle. An adjustable air screw, operated from the outside of the carburettor, protrudes into the "stalk" of the cloverleaf slot, and so permits a very fine adjustment of the air supply for slow-running purposes. This airscrew forms one of the adjustments for determining the *quality* of the mixture. Two methods are adopted for determining its *quantity*. On some models of the carburettor, the slow-running mixture is conducted into the induction pipe through a bypass passage; and the effective aperture of this bypass can be set by means of a second external screw. On other models, designed to suit engines which are less sensitive, no bypass is fitted, and the slow-running mixture is fed direct into the induction pipe through a partial opening of the main throttle; in such cases the ordinary throttle lever stop screws are relied upon to determine the quantity of mixture supplied to the engine in the slow-running position.

Aero Engine Models of the Claudel Carburettor.

There are two main types of Claudel aero carburettors, the "air injector" or single jet, known as the R.A.F. model, and the "diffuser" or pilot jet model, known as the "Z" type. Both the "R.A.F." and "Z" types are made in several models to suit various engines, but the differences between the several models of each type are either purely external or relate to nothing more important than minor modifications of the throttle barrel. It is, however, IMPORTANT that the fullest possible details of the engine and carburettor should be given when ordering replacements. The latest form of the "Z" type, known as the "HC7," embodies two important additions, viz., a vacuum control of the mixture, giving correction for altitude, and adjustable air cones. A totally different form of altitude control is embodied in the special Rolls-Royce carburettor, which is manufactured under licence from the Claudel-Hobson patents. The fundamental differences between the various types are set out below.

R.A.F. or Air Injector Type.

These models have no pilot jet, and no altitude control* is embodied in the original carburettor, though some of them were sent out with airtight lids to the float chambers, and have been equipped with a complete vacuum control for altitude by engine makers. When the engine is throttled right down, it runs on the main jet, the head of which protrudes through the cloverleaf slot into the throttle barrel. Five models of the "R.A.F." type have been issued, viz. :—

"R.A.F. Single."—One spraying chamber; used mostly on Renault engines.
"R.A.F.1A."—Dual spraying chamber.
"R.A.F.2A."—Dual spraying chamber.
"R.A.F.3A."—Dual spraying chamber.
"R.A.F.4A."—Dual spraying chamber.

"Z" or "Diffuser" Type.

Type "Z" in its original form differs from the "R.A.F." type in that the main jet is located at the foot of a central diffuser tube. This diffuser tube carries round its head a number of emulsion holes from which a mixed spray of petrol and air is delivered at all throttle positions except that of slow-running. The head of the diffuser tube comes below the throttle. The slow-running mixture is derived from a pilot jet, which is mounted vertically up the centre of the diffuser tube; and the head of the pilot jet protrudes through a narrow form of cloverleaf slot into the interior of the throttle barrel. Type "Z" carburettors are made with airtight float chambers, so that engine firms can fit up a vacuum control for altitude if they so desire. All the "Z" models have duplex spraying chambers. Apart from two specially elaborated editions of type "Z" described below, there are six models in existence, namely :—

"BZS" and "CZS" for Sunbeam-Coatelen aero engines.
"AZDR" and "CZDR" for Rolls-Royce engines (of R.R. manufacture).
"FZR" for Rolls-Royce engines of Brazil-Straker manufacture.

[The carburettors supplied for the earlier Rolls-Royce engines were designated "CZR," and have been superseded by the CZDR model.]

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* R.A.F. Types (except the Single) manufactured after Sept. 1, 1917, are equipped with altitude control.

Special Models of Type "Z."

In addition to the above, there are two other models of the "Z" type, the "R.R.C.H." and the "HC7," which possess distinctive features separating them from the above patterns. Type "HC7" is at present made for the "Arab" Sunbeam-Coatelen engines, and "RRCH" is specially produced under licence by Messrs. Rolls-Royce for their own engines.

Type "HC7."

This model is identical with the "Z" type in the arrangement of its jets, but has duplex spraying chambers. Its two distinctive features are the vacuum control for altitude and the adjustable cones. The former consists of a lever and cock connecting the airtight space at the top of the float chamber to two separate sources of air supply, one leading from the main air intake, the other communicating with the choke tube in the spraying chamber. The adjustable cones are operated by an external lever; their travel may be set by means of stop-screws, and they provide an additional control for obtaining maximum power, besides facilitating the warming up of the engine in cold weather.

These adjustable cones can further be used for purposes of altitude control. In such cases the cones must be in their midway position when the engine is giving its maximum power at ground level; needless to say, this adjustment can only be obtained by fitting a specially selected jet. When the aeroplane reaches a considerable altitude, the mixture is weakened by lowering the cones.

[Type "C. 7." is manufactured in France for Hispano Suiza engines, and is similar to Type H.C. 7, except that the vacuum control is not fitted.]

Detailed Description of Type "R.A.F."

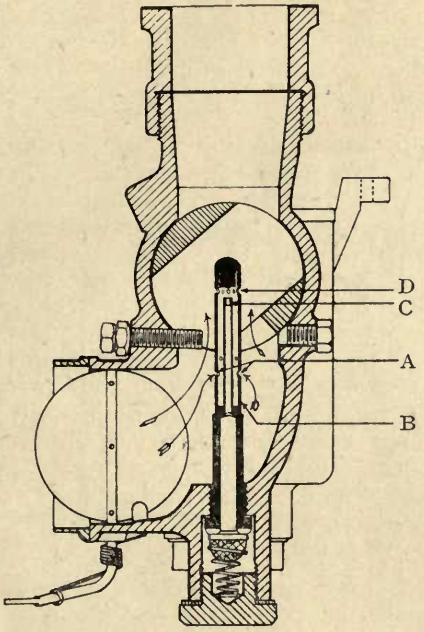
Petrol is supplied in the ordinary way, and controlled by a normal float feed mechanism. Fig. 2 shows the throttle in the closed position with the jet protruding through the cloverleaf slot into the throttle barrel. (Fig. 5 shows the construction of this throttle in perspective. The shape of the clover-leaf slot has been modified in certain R.A.F. models; when indenting for spares, the type and number of the engine should always be specified.) Reference to Fig. 2 indicates that there are two separate air supplies—

(*a*) Through the main intake (as shown by the single-tail arrows).

(*b*) Through the holes marked A (as shown by the double-tail arrows) towards the foot of the air injector tube B which surrounds the jet C. This air injector tube is sealed at its upper end, but has a second set of holes D drilled radially round it near the top.

The functions of these two separate air supplies must be grasped if the action of the carburettor is to be understood.

FIG. 2



Section of Spraying Chamber (R.A.F. Type).

FIG. 3.

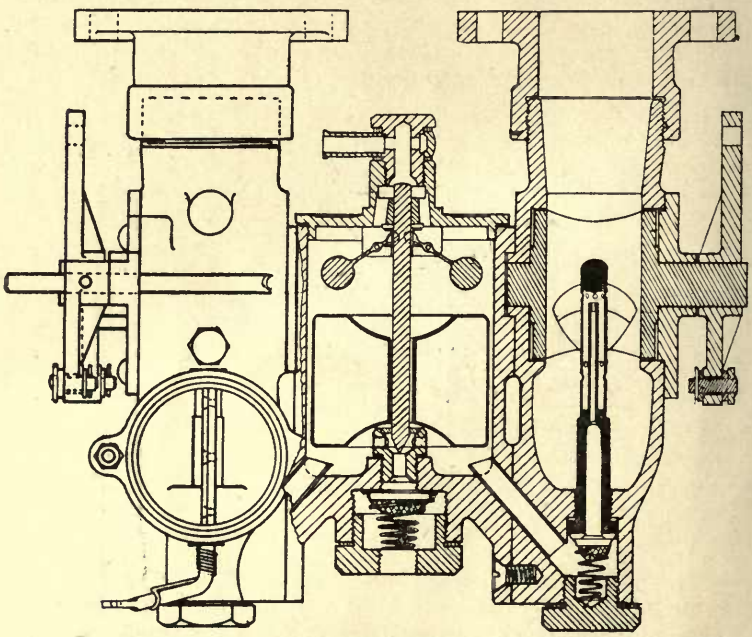
R.A.F. Type of Jet.

When the throttle is closed, the cloverleaf slot in its barrel slides down round the head of the jet, and concentrates the engine suction at that point. Consequently there is a fierce rush of air in at the lower holes A of the air injector tube. As this rush of air passes the holes in the head of the petrol jet C, it draws a good deal of petrol out of them, becomes mixed with the petrol, and splits it up or atomises it. Thus, a column of air, richly impregnated with atomised petrol, finally emerges in a mist-like spray from the delivery holes at the top, and is easily embodied in the column of air derived from the main air intake.

When the throttle is opened, the cloverleaf slot slides away from the head of the jet, the suction is distributed over the whole area of the choke tube, the rush of air up through the air injector tube diminishes, less petrol is drawn out in proportion to engine speed, and the mixture is weakened in quality to suit the increasing speed of the engine.

The airscrew (Fig. 6) can be adjusted to fill up more or less of the "stalk" part of the cloverleaf slot, and thus to cut off part of the air supply which is drawn up through the main body

FIG. 4.



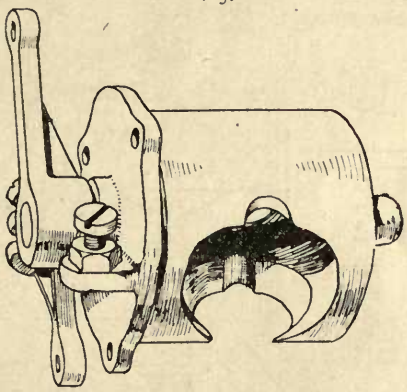
Section of Dual R.A.F. Carburettor.

of the carburettor. If this screw is adjusted inwards, it will obviously tend to enrich the mixture over the whole range of possible throttle positions, the effect being most marked when the throttle is least widely open, and weakening as the throttle aperture increases. The higher adjustable screw, found only when a bypass passage is fitted, sets the effective area of the bypass, and so controls the amount of slow-running mixture supplied to the engine. When no bypass is incorporated, the amount of slow-running mixture is determined by the stop screw limiting the backward travel of the throttle lever outside the carburettor.

Adjustment of " R.A.F." Type.

Before attempting to adjust it is most important to make sure that all the inlet joints are absolutely airtight. The carburettor is fitted with a removable numbered jet. (The A.I.D. issues a list of jet numbers for each type of engine.) No jet should be tampered with in any way, all adjustments being made by fitting an alternative standard size. When a jet of the proper size has been fitted, and the power and revolutions of the engine are satisfactory, the pickup and slower speeds should also be correct, but very occasionally it is necessary, in order to perfect these, to screw the airscrew in slightly, thus enriching the mixture over the whole range of the throttle. (The air screw has been eliminated from certain R.A.F. and Z models.) The greatest effect of the airscrew is felt

FIG. 5.



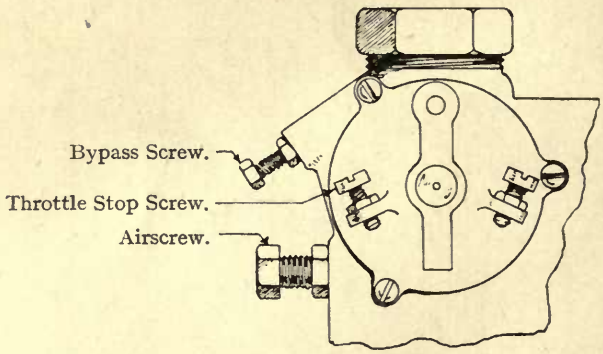
One of the R.A.F. patterns of Throttle Barrel.

when the throttle is nearly closed. The effect dies off as the throttle is opened and at full bore is practically inoperative. This adjustment is of most effect if the valve guides of the engine are worn, or when the mixture is slightly on the weak side. It should, however, be understood that the further the airscrew is withdrawn, the less is the amount of petrol consumed. In fact, it is often advantageous to use a slightly larger jet with the airscrew out than a smaller jet with the airscrew in. Popping in the carburettor is sometimes caused by the fact that the engine will stand very appreciable ignition advance when a Claudel carburettor is used.

For the slow-running of the engine the adjustment is, firstly, by the throttle stop-screw, which regulates the minimum amount of throttle opening, and also regulates the air area below the jet, seeing that the air strangler is part of the throttle

drum ; secondly, by the bypass screw. In some cases perfect slow-running may be obtained by the adjustment of the throttle stop-screw alone. In other cases the bypass screw must be employed to regulate the amount of gas passing through the bypass when the throttle is in the closed position. (Note : This bypass passage is put out of action by the throttle barrel as soon as the throttle is open more than $\frac{1}{8}$th of its range.) With the bypass screw slightly withdrawn and the throttle nearly shut, there is a proportionately larger throttle opening, and therefore a heavier suction on the jet. This means that a richer mixture will be furnished than is obtained with the bypass closed, and the throttle inlet slightly open. Should the action of the throttle remain very sensitive, and the pick-up sluggish after a larger size of jet has been tried, then the carburettor is insufficiently heated.

FIG. 6.



Exterior of a Throttle Valve, showing the various adjusting screws.

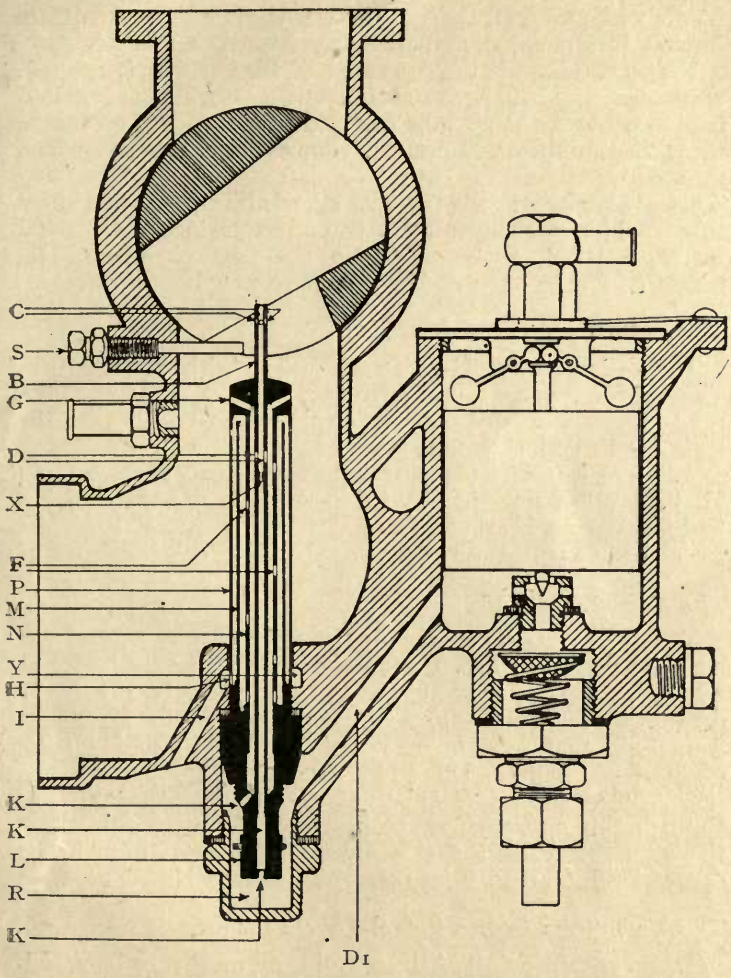
NOTE.—The original R.A.F. jets had straight sides, and were not accurately calibrated. They were ordered to be replaced by the later pattern jet with stepped sides, the calibrations of which are precise. Should a straight R.A.F. jet be encountered, it may be scrapped, and a new stepsided jet substituted.

Detailed Description of Type "Z."

Fig. 7 shows a "Z" type carburettor in section. Petrol leaves the float chamber through the duct D1 and fills the reservoir R, out of which it wells up through the orifices K and fills the three concentric tubes B, N, M to a height which is determined by the adjustment of the needle in the float chamber, though other considerations affect the level when the engine is running. As the orifices K control the supply of petrol, they form the main or power jet, in spite of their

low position in the spraying chamber. For the moment, tubes N and M may be disregarded, and attention should be concentrated upon the slow-running or pilot jet, B. Petrol fills the tube B up to the base of the orifice X; this orifice X

FIG. 7.



"Z" Type of Carburettor in Section.

controls the supply of petrol in the slow-running position, and is therefore the pilot jet. Notice that the diffuser terminates below the throttle barrel, whereas tube B protrudes

into the throttle barrel through a narrow and elongated form of the usual cloverleaf slot. When the throttle is shut, this slot concentrates the engine suction closely round the head of tube B. This concentrated suction draws air at considerable pressure and velocity through the holes D into the upper part of tube B, just above the orifice X. The rush of air picks up petrol through X; the air and petrol are forcibly intermingled, and are sprayed out in a fine mist.

Next consider what happens when the throttle is opened, remembering that a very rich mixture will be required temporarily for the purpose of rapid acceleration, and that a far weaker mixture will suffice as soon as the engine has picked up speed.

Immediately prior to the opening of the throttle, all three tubes B, N, and M are full of petrol up to the level determined by the setting of the needle in the float chamber. The respective duties of tubes N and M must now be studied.

The Diffuser Tube N.

The diffuser tube N is freely drilled with holes FFFF. The diffuser is kept full of petrol up to the float level whilst the engine is throttled down; this petrol arrives through the main jet K, and though it is free to run through the depression holes FFFF into the surrounding tube (or "guard tube") M, its level is not thereby affected. The depression holes FFFF have no bearing whatever upon the petrol level but are drilled to permit air to enter tube N, as described below.

The Guard Tube M.

The guard tube M surrounds the diffuser tube N, and has no holes drilled in it. Its function is to maintain petrol at a high level in N in view of the fact that the tube N is freely drilled with holes. The upper lip of the guard tube M extends 8 mm. above the maximum petrol level fixed by the setting of the float needle. There is a good clearance between the upper lip of the guard tube and the head of the diffuser: through this clearance air rushes into the guard tube from the outer air tube P; this air finally passes through the depression holes FFFF into the diffuser tube N.

The Variations in the Petrol Level.

An important detail of the petrol level must now be noted. In most float-feed carburettors a constant level of petrol is maintained in the spraying chamber, but this is not the case with the type "Z" Claudel. The adjustment of the float needle fixes a *maximum* petrol level in all three tubes B, N, and M, but this maximum level is *not a constant level.* The

maximum level is maintained so long as the engine is throttled down and petrol is only being withdrawn from the pilot jet B. In some models the pilot jet B has a separate petrol supply duct of its own ; in others it receives its supply through the ducts or main jets K (Fig. 7), but in either model the supply is ample to maintain the maximum petrol level in the pilot jet so long as only the pilot jet is in action.* But when the throttle is opened, and petrol is being vaporised from the diffuser tube N as well as from the pilot jet B, the supply is no longer sufficient to maintain the maximum level and the level sinks rapidly in all the three concentric tubes which contain petrol, viz., B, N, and M, because their united capacity for petrol is too large to be kept filled by the supply coming through K. The variations in the petrol level may be set out as follows :—

(1) Throttle shut. Maximum level in all three tubes B, N, and M.

(2) Throttle just opening. Petrol is waiting at maximum level in all three tubes, ready to supply a rich mixture for the purpose of acceleration. As this waiting reserve of petrol is drawn off into vapour, the orifice K cannot fill up the tubes, and the level sinks.

(3) Throttle remains open. The petrol level sinks to a point which varies permanently with the size of the orifice K, and varies temporarily with the engine speed. The strength of the mixture is thus corrected by the varying petrol level to suit each gradation of engine speed.

In other words, whenever the throttle is shut, a reserve of petrol accumulates, ready to furnish a strong mixture when the pilot accelerates, and whenever the engine picks up after an acceleration, the mixture is automatically weakened down to the correct proportions.

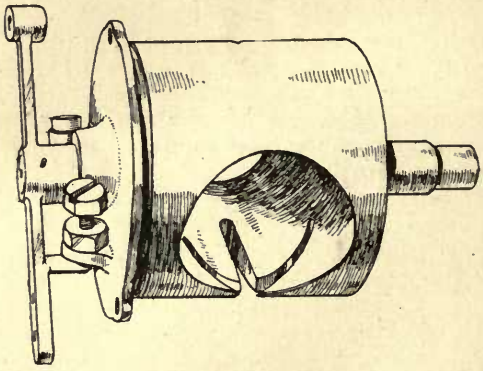
Action of the Diffuser Air Holes.

In cruder types of carburettor petrol waits at a constant level close beneath the jet delivery nozzle, ready for a rush of air outside the jet to pick it up. As the petrol level varies over a range of approximately two inches in this special diffuser tube, measures must obviously be taken to concentrate the air suction near the surface of the petrol, be it high or low.

* Jets furnished with a separate petrol lead to the pilot jet are stamped with the letters "CZB." In changing jets of a Z or HC7 type, the jets must be examined, care being taken only to replace CZB jets with jets of the same design.

It is for this purpose that air holes are drilled at intervals in the diffuser tube N from its top to its bottom. As the engine sucks, air is drawn in at the duct I, whence it passes into the annular or ring-shaped chamber Y, and so into the outer air tube P. Rushing up P the air passes over the upper lip of the guard tube M and travels through the depression holes FFFF into the tube N. When air passes through any of the holes FF, which chance to be above the surface of the petrol, such air will pick up petrol unless the petrol is far below the holes, but air also rushes down through the petrol to enter the lower holes FF, which are beneath the petrol level, and such air bubbles up through the petrol in N and becomes richly carburetted in its passage through the spirit. Consequently, a fine mist, consisting of petrol spray and of air

FIG. 8.



"Z" Type of Throttle Barrel.

highly impregnated with petrol, finally issues through the emulsion holes GG at the top of the diffuser. This spray impinges at a sharp angle and at high velocity into the column of air passing up the main choke tube from the main air intake and a very homogeneous mixture results.

When the engine settles down to high revolutions after an opening of the throttle, the level of petrol in the tubes B, N, and M sinks, the lower depression holes FF are uncovered, and a balance of pressure, relative to the engine speed and throttle opening, is set up.

Adjustment of Type "Z."

All the petrol passes through the hole (or holes) K in the plug L, consequently whenever the term "main jet" or "power jet" is used in respect of a type "Z" carburettor, it refers to the

plug L, which is the basis of all settings. Similarly, the strength of the slow-running mixture is primarily determined by the size of the orifice X in the pilot jet B.

Care must be taken not to tamper with the diffuser, *i.e.*, the unit composed of tubes P, M, N. This is originally proportioned to suit (*a*) the effective diameter of the induction pipe, and (*b*) any peculiarities of the particular design of engine for which it is supplied. Moreover, the series of holes in the outer air tube P, the diffuser tube N, and the diffuser head G, are in relative proportion to each other ; so that any meddling with these parts is likely to have disastrous effects on the working of the carburettor. The main jet and the pilot jet are the only parts which can repay alteration, and in experiments with these it is folly to use a broach ; standard replacements in calibrated sizes can be obtained from the makers.

When a lack of power or deficiency of revolutions is traced to the carburettor, a larger main jet may be tried ; if, on the other hand, there are indications of an over-rich mixture, a smaller main jet should be substituted.

In adjusting the bypass (or throttle stop) and the airscrew in attempts to perfect the slow-running, the engine should first be allowed to attain its normal working temperature. A mixture which gives admirable results with a cold engine will invariably prove too rich when the engine is hot, and will then allow the engine to run too fast.

The type " Z " carburettors have an airtight float chamber, which is sometimes connected in installation by external pipes to the spraying chamber. Where engine makers have fitted such connections, great care is needed in reassembling to insure an airtight joint at all unions in the connections. Otherwise, the leaks will produce atmospheric pressure in the float chamber, and the device will fail to give any vacuum control.

The parts of the carburettor which admit of adjustment are standardised to fit the engine for which it is supplied, with the exception of the setting for slow running. It is thus obvious that if any trouble is traced to the carburettor, it can only arise from derangements of the petrol supply.

Shortage or stoppage in the petrol supply may arise from dirt in the petrol tank or supply pipes, choked petrol filters, air lock in the feed piping, needle valve worn and sticking in its seating, balance weights binding on the collar of the needle valve, choked jets, or excessive heat causing the formation of petrol vapour in the supply pipes or jets.

Excess of petrol, or " flooding," may be due to a damaged, bent, or eccentric needle valve, a faulty seating, broken washer

on jet or needle valve seating, too high a petrol level, damaged float, needle binding on balance weights, excessive pressure in the petrol tank, dirt between the needle valve and its seating.

It should not be necessary to dismantle the central tube, but in case of emergency it can be dismantled as follows, provided the parts have not been soldered up after calibration.

After the plug at the base of the spraying chamber is removed, the tube may be unscrewed by the special key. The slow-running tube can then be unscrewed from its base-plug, and the holes at its head and base examined, not forgetting the pilot jet some two-thirds of the way up its central bore.

It is not advisable to dismantle the diffuser, but should this be necessary, the diffuser head must be gripped between two pieces of lead in a small vice, and unscrewed from the base-plug. The diffuser tube N is made in one piece with the diffuser head, and comes away with it, clearing the depression holes FF, the guard tube M, and the outer air tube P, for inspection purposes. In replacing the parts, the air holes of the outer tube must come at the bottom and the diffuser head must be screwed down tightly, so as to make an airtight union at its joint with the outer tube.

All these parts are very lightly made, and it is essential that they should only be disturbed when the cause is serious and spares are not available.

Derangements of the slow-running are almost invariably due to foreign matter in the pilot jet or to air leaks at one of the joints.

The airscrew in type "Z" acts only on the pilot jet and, being very slender, has no appreciable effect except in the slow-running position.

Detailed Description of Type "HC7."

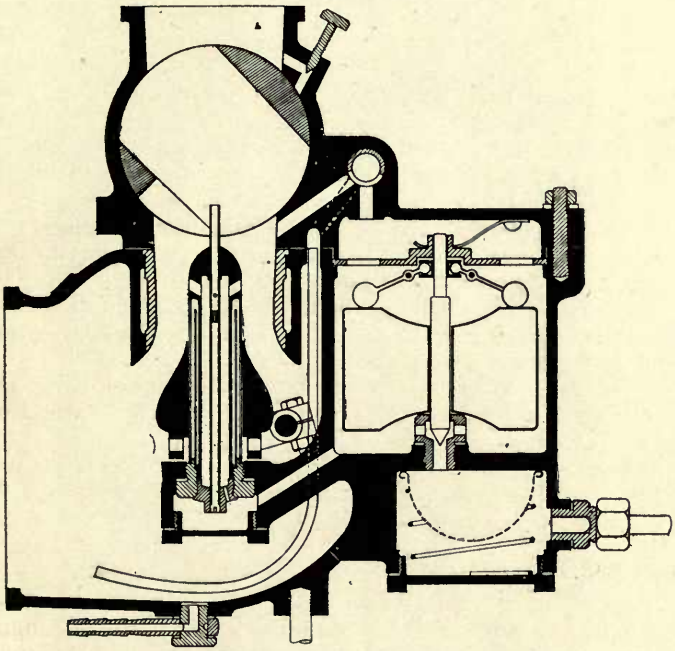
Type "HC7" is a new edition of type "Z," evolved specially to suit the Sunbeam-Coatelen "Arab" engine. It differs from type "Z" in three respects. The pilot jet usually has a separate petrol supply of its own instead of being fed through the main jet, and the head of the tube B is open instead of being sealed by a plug. A vacuum control of the mixture is incorporated, and gives correction for altitude. The air cones fitted in the main air supply are movable vertically by means of a lever, and their travel is further adjustable by means of a stop-screw.

The Altitude Control.

At the altitudes reached by aeroplanes the density of the atmosphere decreases so appreciably as to have a serious

effect upon carburation. For example, if a carburettor is set to supply a mixture of 14 parts of air to one part of petrol at 1,200 revolutions per minute on the ground, the mixture will be no longer correct at 10,000 feet, because the density of the air at that height is so much reduced that a larger percentage of air is required to give a perfect mixture. Altitude controls must therefore either reduce the supply of petrol in proportion to the height attained or, alternatively, increase the supply of air. In the "RRCH" type the petrol supply is cut

FIG. 9.



Section of "HC7" Type.

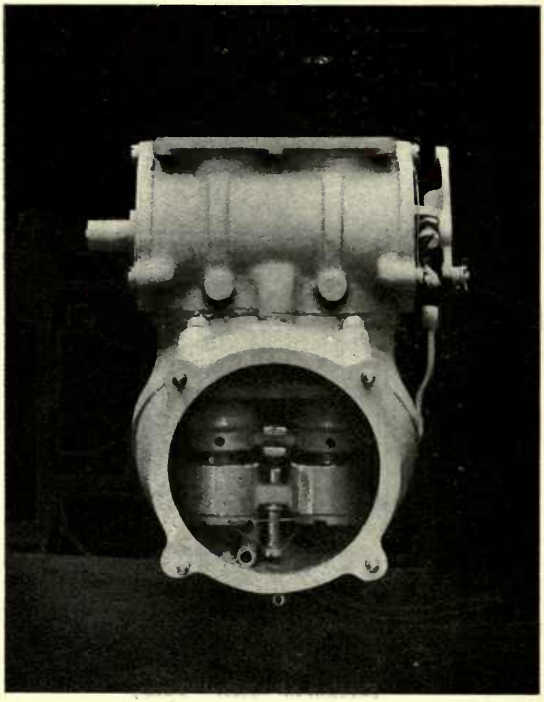
down at high altitudes by means of a needle valve in the feed system. In type "HC7" the petrol supply can be cut down as much as 65 per cent. by a vacuum control, now to be described.

In ordinary carburettors the lid of the float chamber is not airtight, and the air above the petrol in the float chamber is consequently at atmospheric pressure. The air above the petrol in the jet is at a reduced pressure, and the superior pressure in the float chamber consequently causes petrol

to flow into the jet. The flow of petrol is thus due to the superior pressure in the float chamber.

In type "HC7" the float chamber is airtight, and the pressure of the air in the chamber is within the pilot's control, as follows : a duct cast in the body of the carburettor casing connects the airtight float chamber to a cylindrical chamber controlled by a cock and lever (Fig. 11). Three passages,

FIG. 10.



"HC7" Type, showing Adjustable Air Cones.

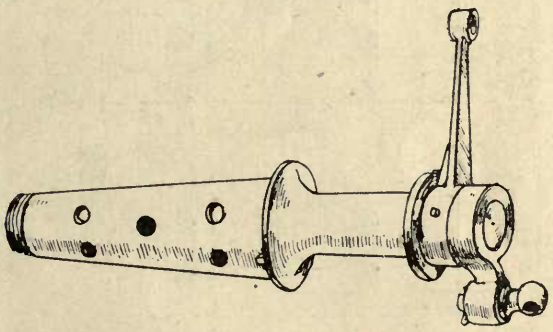
cast in the casing, connect this chamber to two sources from which air can be led to the space at the top of the float chamber. Of these three passages, the central duct communicates with the lower part of the spraying chamber, and normally supplies the float chamber with air at approximately atmospheric pressure, a little more or a little less. When the cock opens up this duct only, the carburettor works like a normal type.

The other two passages communicate with the choke tube surrounding the head of the diffuser, where there is a partial vacuum due to engine suction.

When the engine is running on the ground, the first duct is open ; the petrol in the float chamber is practically under atmospheric pressure ; the petrol in the jet is under a very reduced pressure ; and a full flow of petrol is assured. As the aeroplane climbs, the pilot operates his vacuum control lever, and opens up the other ducts. The air pressure in the float chamber is appreciably reduced, and the flow of petrol to the jet is correspondingly reduced. As altitude is simultaneously reducing the density of the air supply, the proportions of the mixture are kept approximately correct.

Four positions of the vacuum control cock may be distinguished, and for convenience in nomenclature the duct from

FIG. 11.



"HC7" Altitude Control Cock.

the control cock to the air intake is termed a "leakhole," and the two ducts from the control cock to the choke tube are termed "suction holes."

(1) Leakhole coupled up to float chamber. (This position is for use at ground level and low altitudes.)
(2) Leakhole open, suction holes partly open. (For use at low altitudes.)
(3) Leakhole open, suction holes fully open. (For use at moderate altitudes.)
(4) Leakhole shut, suction holes fully open. (For use at great altitudes.)

In actual practice a pilot need not concern himself with the details and principles of the control, but will merely operate the lever to give the best results as recorded by his instruments.

FIG. 12.

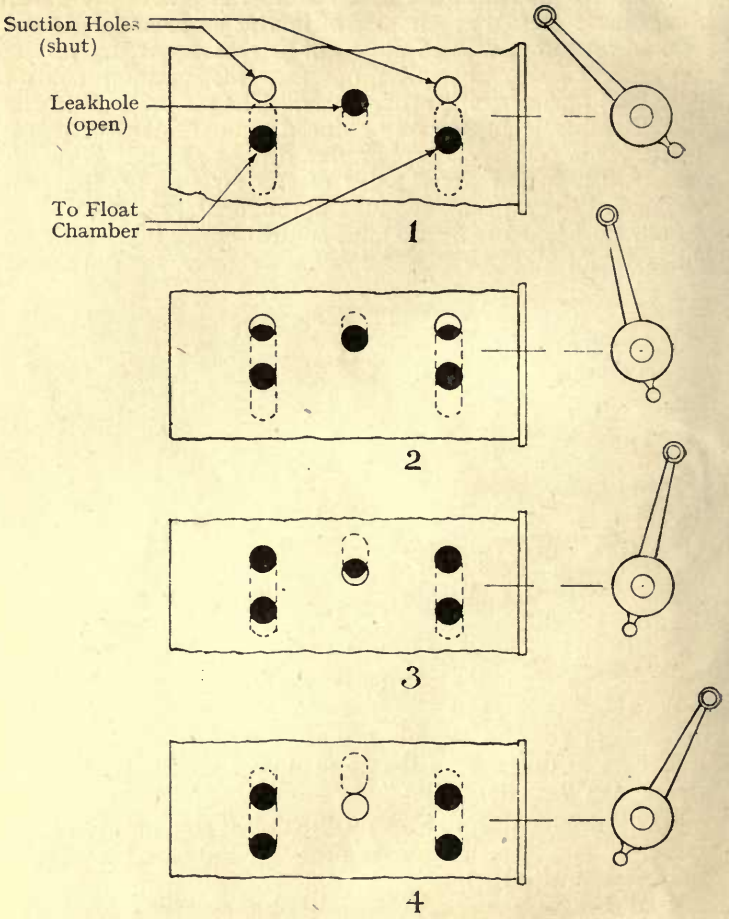


Diagram illustrating action of altitude control cock in Type "HC7."

○ = Shut.

● = Open.

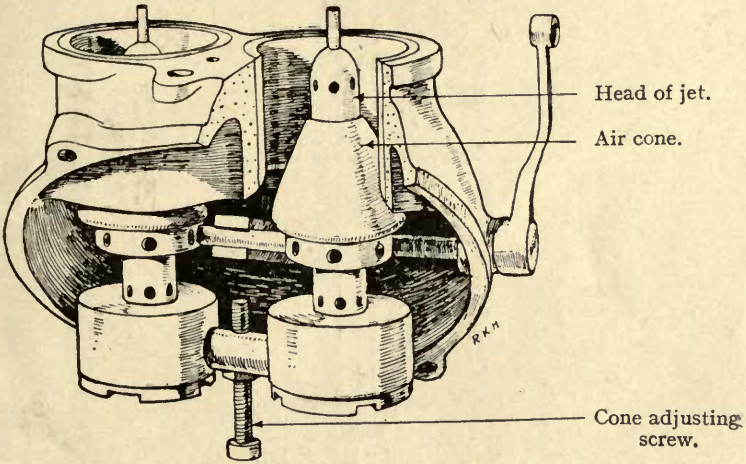
Adjustable Air Cones.

Fig. 13 shows the construction of this additional control. As the air cones rise and fall, they modify the quantity and velocity of the main air supply, and so enable the pilot to extract the maximum power from his engine. In the position of maximum lift they will be found very useful to facilitate warming up the engine in cold weather.

Fitting Notes.

See that the face of the induction pipe flange is absolutely true before attempting to fit a carburettor. Quite apart from the trouble which would be caused by air leakages, a

FIG. 13.



Adjustable Air Cones in Type "HC7."

true face is essential to avoid distorting the body of a light aero carburettor, which would lead to the throttle working stiffly, or even jamming.

A stupid mechanic might then attempt to cure the trouble by easing the throttle barrel, when further air leakages would wholly upset the working of the carburettor.

Thin fibre washers should be exclusively used for all joints, unions and diffusers. The sole exception is the joint between the two parts of the carburettor body, which should be made of paper, not exceeding ·01 inch in thickness.

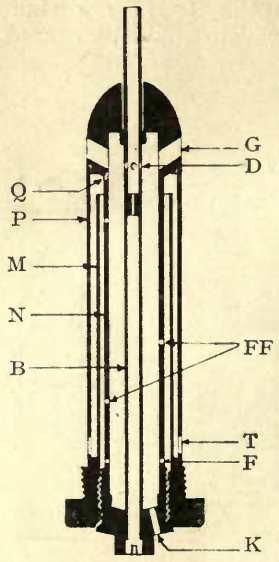
The peculiarly shaped air intake mouth is designed to catch any petrol drips, which are conducted by a special drain-tube

to a safe escape outside the fuselage. Unless the joints of the catchpit are made petrol-tight the value of this safety device is cancelled.

The main diffuser body should always be screwed tightly home by the special key provided, and never by first fitting the main jet in the diffuser and then using the jet key to screw the group home.

The air supply holes to the diffuser always come at the BOTTOM.

FIG. 14.



Section of "HC7" Jet.

T—Holes by which air enters the tube P.
Q—Air release, to prevent syphoning.
For explanation of the other letters, *see* p. 12.

All the parts of the diffuser, except the main and pilot jets should be soldered together after the holes are calibrated. The depression tube is then expanded into the case of the diffuser after gauging the holes FFFF. Damage is certain to ensue, if any attempt is made to dismantle these parts. The calibration of the holes in the diffuser and the jets is most important, as any variation in these will directly affect the power and the consumption. The external adjustments provided by the air cones, in conjunction with the official jets, give all the range of setting which is likely to be needed in

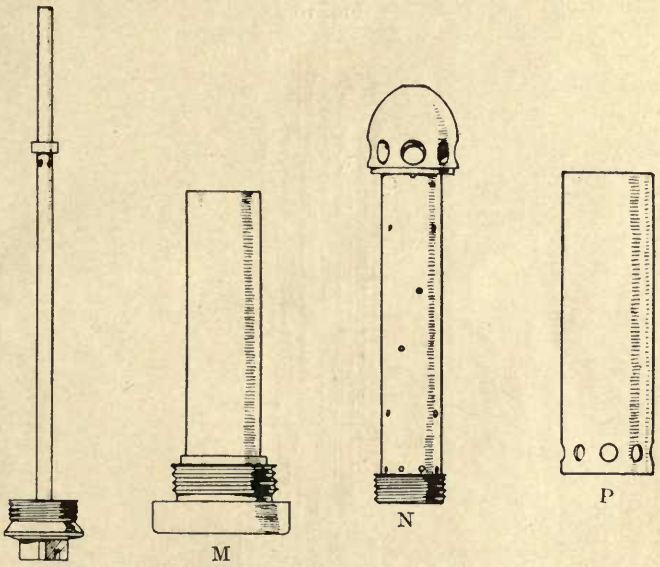
squadron work, thus relieving local staffs from tampering with the diffusers, which cannot safely be altered without special knowledge and experience.

The main jet must make a petrol tight joint at the conical seating to insure that petrol can only reach the engine through the calibrated orifice.

The pilot jet should be soldered into the main jet after calibration.

The movement of the altitude control lever on the carburettor is necessarily short, owing to the limited travel of the

FIG. 15.



"HC7" Jet shown dismantled.

(For explanation of letters, *see* p. 12.)

small diameter cock. The leverage should therefore be multiplied in connecting this lever to the control in the cockpit.

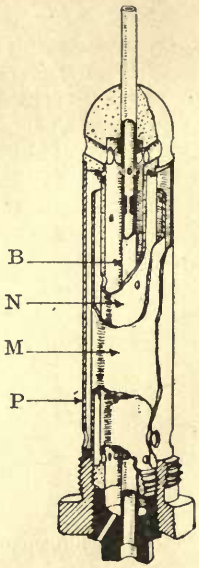
The vacuum control cock is interchangeable in the event of wear or damage. Under no circumstances should the ducts or slots be tampered with in squadrons.

If the petrol is pressure fed, the pressure should never exceed 3 lbs. per square inch. If fuel is supplied by gravity, the head should never be less than two feet. The float chamber seating is calculated to deliver about 16 gallons per hour with a head of 20 inches.

Normal Adjustments.

Slow-running adjustments must be made when the engine is warm. After securing that setting on which the engine just continues to run, the bypass screw should be unscrewed a trifle, when the engine speed will increase. To slow down, reset the stop screw on the throttle. This will have the effect of making the mixture slightly richer by reducing the effective area of the slot in the lower half of the throttle. If a weaker mixture is desired than is furnished with the bypass closed, a smaller jet is necessary; such an event is extremely unlikely, as the jets are carefully selected in exhaustive bench tests.

FIG. 16.



"HC7" Jet in partly sectioned perspective.
(For explanations of index letters, *see* p. 12.)

The adjustable aircones must be relied upon to render the broad setting of the diffuser more exact. If the air cones are set to give a little less than maximum power, marked reductions in fuel will be secured.

Possible causes of trouble :—

(1) Choked jets.
(2) Insufficient lift of float chamber needle valve (the correct level is 8 mm. below top of guard tube in diffuser).

(3) Altitude control open at or near ground level.
(4) Throttle not opening fully.
(5) Air leak at float chamber cover ; this will cause a rich mixture.

Special Notes on the Use of the Altitude Control.

The control should be " closed " at ground level, *i.e.*, in that position at which the cock opens the duct to the main air intake, otherwise called a " leakhole."

The control will begin to make an appreciable difference in the power and revolutions when a height of 6,000 feet is exceeded ; and at less altitudes it will effect a real fuel economy even if it does not perceptibly improve the power output.

The control, if open, is automatically returned to the " closed " position whenever the throttle is shut.

Pilots should remember to reopen the altitude control when flattening out at levels of 3,000 feet and over after diving down from a greater height. When the throttle is shut for a dive, the altitude control is simultaneously shut off, and if the machine is flattened out again whilst still several thousand feet up, the petrol supply will be excessive until the altitude control is brought back into action.